PTO 03-2820

Japanese Patent

Document No. 2-227340

TERMINAL DEVICE

[Tanmatsu Sochi]

Yuzo Kadomuki, Koji Kameshima, and Makoto Yamakado

UNITED STATES PATENT AND TRADEMARK OFFICE

Washington, D.C. April 2003

Translated by: Schreiber Translations, Inc.

Country	:	Japan
Document No.	:	2-227340
Document Type	:	Kokai
Language	:	Japanese
Inventor	:	Yuzo Kadomuki, Koji Kameshima, and Makoto Yamakado
Applicant	:	Hitachi, Ltd.
IPC	:	B 60 K 35/00 G 02 B 27/02 G 06 F 3/153 G 09 G 5/00 5/02
Application Date	:	March 1, 1989
Publication Date	:	September 10, 1990
Foreign Language Title	:	Tanmatsu Sochi
English Title	:	TERMINAL DEVICE

/1[1]

Specification

1. Title of the invention

Terminal device

2. Patent Claims

1. A terminal device with the following characteristics: In a terminal device which displays information or commands on an operator's forward field of vision in overlapping fashions,

A forward field of vision observation mechanism which enables the observation of the forward field of vision of the aforementioned operator that serves as a background in the context of displaying the aforementioned information or commands is configured, and

The method for displaying the information or commands is changed in accordance with the status of the forward field of vision observed through said forward field of vision observation mechanism.

2. A terminal device specified in Claim 1 characterized by the fact that the aforementioned forward field of vision observation mechanism enables the observation of the color of the forward field of vision of the operator that serves as the background in the context of displaying the aforementioned information or commands and then changes, in accordance with the

[1] Numbers in the margin indicate pagination in the foreign text.

observed color of the forward field of vision, the color of the displayed information or commands into a color that can be easily identified by the operator.

3. A terminal device specified in Claim 1 characterized by the fact that the aforementioned forward field of vision observation mechanism enables the observation of the color of the forward field of vision of the operator that serves as the background in the context of displaying the aforementioned information or commands and then changes, in accordance with the observed color of the forward field of vision, the position of the displayed information or commands into a position that can be easily identified by the operator.

4. A terminal device specified in Claim 1 characterized by the fact that the aforementioned forward field of vision observation mechanism enables the observation of the brightness of the forward field of vision of the operator that serves as the background in the context of displaying the aforementioned information or commands and then changes, in accordance with the observed brightness of the forward field of vision, the intensity of the brightness of the displayed information or commands into one that can be easily identified by the operator.

5. A terminal device specified in Claim 1 characterized by the fact that the aforementioned forward field of vision observation mechanism enables the observation of the brightness of the forward field of vision of the operator that serves as the background in the context of displaying the aforementioned

information or commands and then changes, in accordance with the observed brightness of the forward field of vision, the brightness of the displayed information or commands in such a way that a constant differential will perpetually be maintained between the brightness of the forward field of vision and the brightness of the displayed information or commands.

6. A terminal device specified in Claim 1 characterized by the fact that the aforementioned forward field of vision observation mechanism enables the observation of the brightness of the forward field of vision of the operator that serves as the background in the context of displaying the aforementioned information or commands and then changes, in accordance with the observed brightness of the forward field of vision, the position of the displayed information or commands into a position that can be easily identified by the operator.

7. A terminal device specified in Claim 1 characterized by the fact that the aforementioned forward field of vision observation mechanism enables the observation of a landscape projected on the forward field of vision of the operator that serves as the background in the context of displaying the aforementioned information or commands and then changes, in accordance with the change of the landscape projected on the observed forward field of vision, the position of the displayed information or commands.

8. A terminal device specified in Claim 7 characterized by the fact that the aforementioned forward field of vision

observation mechanism enables the observation of a landscape projected on the forward field of vision of the operator that serves as the background in the context of displaying the aforementioned information or commands and then changes, in accordance with the change of the landscape projected on the observed forward field of vision, the position of the displayed information or commands in such a way that the information or commands will be displayed at a /2
fixed position within the landscape projected on the observed forward field of vision.

9. A terminal device with the following characteristics: In a terminal device which displays information or commands on an operator's forward field of vision in overlapping fashions,

Said terminal device is mounted on a transportation vehicle, and the position for displaying the information or commands is changed, based on the information on the movement of said transportation vehicle and on information specific to a path on which said transportation vehicle is operated, in such a way that information concerning a specific point on said path will be displayed at a position corresponding to said point as it is projected on the forward field of vision of the aforementioned operator.

3. Detailed explanation of the invention

(Industrial application fields)

The present invention concerns a terminal device, and more specifically, it concerns a display method for a terminal device such as a heads-up display which is used for displaying information or commands on an operator's forward field of vision in overlapping fashions.

(Prior art)

A heads-up display, which represents a type of terminal devices, is used mainly as a mechanism for providing an operator with information or commands necessary for airplane takeoff and/or landing, navigation, etc. More specifically, the information or commands scheduled to be given to the operator is displayed on the operator's forward field of vision in overlapping fashions, and therefore, the operator can maneuver the plane by exclusively observing the outside without casting alternate glances at the instrument board and the forward field under the most challenging operative conditions, namely during the takeoff/landing, etc.

An operator for an airplane equipped with no heads-up display must operate the plane while decoding the airplane flight statuses and course designations from multiple instruments on the instrument board, and (s)he must cast alternate and frequent glances between the outside and the instrument board under challenging operative conditions, namely during the takeoff/landing, etc. In such a case, the operator must switch his or her eye focus from infinity to short distance modes. The human eye, however, cannot render instantaneous responses, due to

which a momentary blank period arises, and accordingly, not only does the experienced tension increase, but the degree of danger also becomes higher.

As far as the heads-up display is concerned, on the other hand, the necessary information or commands are displayed on the operator's forward field of vision in the infinity focal mode, and therefore, the operation can view such vital information or commands while simultaneously observing the outer landscape. As a result, the operation load imposed on the operator can be alleviated, and the safety can be ensured.

Incidentally, an example of the devices of the prior art is mentioned in Isao Iwasaki, "Trends and problems of heads-up displays," Nihon Koku Uchu Gakkaishi, Vol. 36, No. 408 (January 1988).

(Problems to be solved by the invention)

As far as the aforementioned technique of the prior art is concerned, however, it is often difficult for the operator to identify the displayed information or commands depending on the state of the forward field of vision in a case where the operator is assigned to a terminal device wherein the information or commands constitute a display background (display operator = airplane pilot in the case of the aforementioned airplane heads-up display), and it cannot be said that adequate measures are taken for facilitating the identifications of the information or commands by the operator.

HUD

The objective of the present invention, which has been conceived for solving the foregoing problem, is to provide a terminal device which is capable of displaying information or commands that can be easily identified by an operator regardless of the state of the operator's forward field of vision.

(Mechanism for solving the problems)

The following constitution is provided by the present invention for achieving such an objective: In a terminal device which displays information or commands on an operator's forward field of vision in overlapping fashions, a forward field of vision observation mechanism which enables the observation of the forward field of vision of the aforementioned operator that serves as a background in the context of displaying the aforementioned information or commands is 13
configured, and the method for displaying the information or commands is changed in accordance with the status of the forward field of vision observed through said forward field of vision observation mechanism, based on which information or commands that are easily identified by an operator can be displayed.

(Functions)

The method for displaying the information or commands is changed in accordance with the status of the operator's forward field of vision based on the aforementioned constitution, by

virtue of which the operator can always identify the displayed information or commands with ease.

(Application examples)

In the following, application examples of the present invention will be explained with reference to figures.

Figure 1 is a diagram which shows the overall constitution of the first application example of the terminal device of the present invention.

In Figure 1, (1) is a signal processing unit that formulates information or commands displayed for an operator or symbols which represent such information or commands (in the following, said information or commands displayed for an operator and symbols which represent such information or commands will be referred to collectively as the "symbols"), whereas (2) is a CRT which displays such symbols based on the signals transmitted from the signal processing unit (1), whereas (3) is an optical system which converts the symbols displayed on the CRT (2) into infinity-focused images for the operator, whereas (4) is a combiner which overlaps the symbols with a landscape projected on the operator's forward field of vision, whereas (5) is a color camera which photographs the operator's forward field of vision.

The signal processing unit (1) processes information inputted from an external source (e.g., signal obtained from a sensor, etc.), determines the type, color, brightness, or display position of the symbols to be displayed for the operator, and then outputs

signals that are necessary for the display into the CRT (2). The signal processing unit (1), furthermore, images the forward field of vision photographed by the color camera (5) on-screen, based on which the color and brightness of the forward field of vision are identified. In a case where the color of the symbol to be displayed is identical to the color of the portion of the forward field of vision that constitutes a background for the symbol or where it is difficult for the operator to identify the symbol due to an insufficient contrast between the respective colors of both, the signal processing unit (11) changes the display position of the symbol into a position at which the operator can easily identify said symbol based on a sufficient contrast between the respective colors of the symbol and background. Figure 2 is a modelwise diagram which shows the relationship between the symbol and landscape projected concomitantly on the operator's forward field of vision.

Figure 3, which pertains to the second application example of the present invention, is a modelwise diagram which shows the relationship between the symbol and landscape projected concomitantly on the operator's forward field of vision in a case where the respective colors of the symbol to be displayed and the portion of the forward field of vision that constitutes the background for said symbol are mutually identical or where it is difficult for the operator to identify the symbol due to an insufficient contrast between the respective colors of both (e.g., where the color [of the symbol is] complementary to that of the

background). The significance of this method lies in the symbol display position, and it is effective in a case where it is undesirable to change the display position or where the symbol cannot be easily identified by simply changing the display position due to the identicalness or similarity of the color of the forward field of vision.

Figure 4, which pertains to the third application example of the present invention, is a modelwise diagram which shows the relationship between the symbol and landscape projected concomitantly on the operator's forward field of vision in the context of the repositioning of the symbol display position by the signal processing unit (1) in a case where the respective brightnesses of the symbol to be displayed and the portion of the forward field of vision that constitutes the background for said symbol are mutually identical or where it is difficult for the operator to identify the symbol due to an insufficient contrast between the respective brightnesses of both.

Figure 5, which pertains to the fourth application example of the present invention, is a modelwise diagram which shows the relationship between the symbol and landscape projected concomitantly on the operator's forward field of vision in the context of the redesignation of the symbol brightness by the signal processing unit (1) in such a way that the symbol will become brighter than the background in a case where the respective brightnesses of the symbol to be displayed and the portion of the forward field of vision that constitutes the background for said

symbol are mutually identical or where it is difficult for the operator to identify the symbol due to an insufficient contrast between the respective brightnesses of both. If a constant differential is orchestrated to be perpetually maintained between the brightness of the background and the brightness of the symbol in this case, furthermore, the displayed symbol continually remains highlighted against the background in the operator's field of vision at a constant contrast ratio, based on which the symbol can be accurately recognized without entailing unnecessary tension for the operator due to the irregularity of the highlighting intensity. Depending on the types of symbols, furthermore, accidents such as the overlooking of an important symbol, etc. can be avoided if the brightness of a symbol with a high degree of significance is designated to be higher not only than the brightness of the background but also than the brightness of the other symbols.

Next, the fifth application example of the present invention will be discussed below.

The fifth application example is especially effective in a case where the terminal device of the present invention is utilized as a heads-up display for an operator of a transportation vehicle (e.g., airplane, automobile, etc.), and a case where it is mounted on an automobile will be instantiated below in the present application example.

One notable characteristic of a case where the terminal device of the present invention is mounted on an automobile lies

in the continuous change of the landscape projected on the forward field of vision in accordance with the movement of the automobile, whereas another lies in the fact that information vital to the operator of the automobile (equivalent to the operator of the terminal device) is often peculiar to a certain point within the landscape outside the automobile.

Figure 6, which is provided for explaining these characteristics, is an approximation diagram which shows the manner by which the automobile (6), on which the terminal device of the present invention is being mounted, travels on the road. The intersection (7) is located in front of the automobile (6) along its direction of movement, whereas the road information transmission device (8), which transmits, to a vehicle traveling ahead, sets of information such as the distance to the intersection (7), respective branching destinations of the intersection (7), etc., is installed on the side of the road along which the automobile (6) travels, namely on its left side. Figure 7 is a diagram which shows the forward field of vision of the operator of the automobile (6) at the moment where said automobile has passed in front of the road information transmission device (8). The respective branching destinations of the intersection (7) are hereby displayed as symbols. Such an embodiment wherein the symbols that express the respective branching destinations are displayed on the respective branching roads projected on the operator's forward field of vision can be realized with ease by using not only the information concerning the distance to the

intersection (7), which has been transmitted from the road information transmission device (8), but also the standard positional profile from the operator's perspective. In a case where the symbol display position remains fixed at an invariable position within the forward field of vision, however, the landscape projected on the operator's forward field of vision changes in accordance with the movement of the automobile (6), and therefore, the symbol display position comes to progressively deviate from the position of each branching road which is being projected on the forward field of vision, as Figure 8 indicates.

As the overall constitutional diagram of Figure 9 indicates, as far as the fifth application example is concerned, the signal processing unit (1) receives not only the information from the road information transmission device (8) but also the traveling velocity, movement direction, and posture of the automobile (6) and then shifts the symbol display position within the operator's forward field of vision in accordance with the movement of the automobile (6). In the case of the state shown in Figure 6, the distance between the automobile (6) and intersection (7) is calculated based not only on the time elapsed since the passage of the automobile (6) in front of the road information transmission device (8) but also on the traveling velocity of the automobile (6), as a result of which the symbol becomes constantly displayed on each branched road at the intersection (7) (Figure 10).

Incidentally, in the case of the state shown in Figure 6, the road is straight, and the movement direction of the automobile (6)

and its posture in relation to its movement direction are constant, due to which the traveling velocity of the automobile (6) alone is used for the calculation executed in the context of shifting the symbol display position by the signal processing unit (1), although it goes without saying that such sets of information as the movement direction and posture of the automobile (6) can also be inputted for effectively implementing the present invention in relation to roads with complex shapes.

Effects similar to those of the case of the automobile can, furthermore, be achieved by directly mounting the terminal device of the present invention on transportation vehicles other than the automobile (e.g., airplanes, trains, etc.).

(Effects of the invention)

As has been mentioned above, as far as the present invention is concerned, the method for displaying information or commands is changed depending on the status of the operator's forward field of vision, based on which it becomes possible for the operator to constantly identify the displayed information or commands with ease regardless of the status of the forward field of vision.

4. Brief explanation of the figures

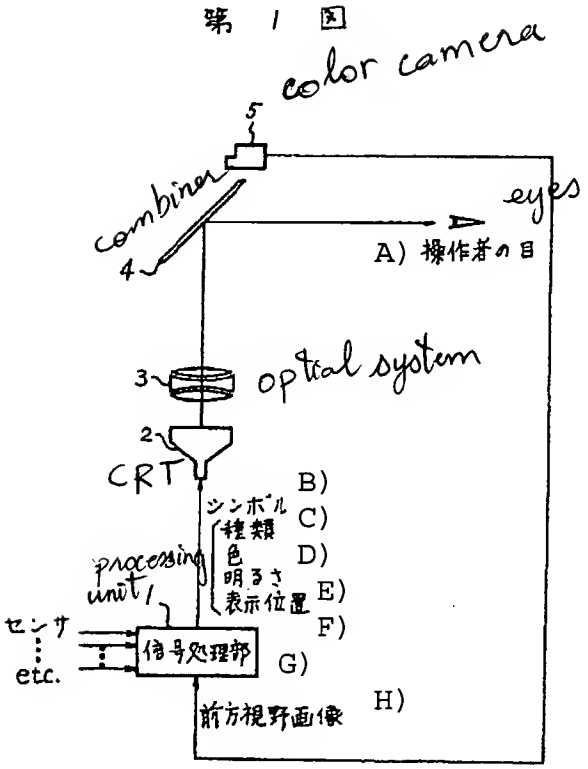
Figure 1 is a diagram which shows the overall constitution of the first application example of the terminal device of the present invention, whereas Figure 2 is a modelwise diagram pertaining to the forward field of vision of the operator of the

terminal device, whereas Figures 3, 4, and 5 are respectively modelwise diagrams pertaining to the forward fields of vision of the operators of the terminal devices of the second, third, and fourth application examples of the present invention, whereas Figure 6 is a demonstrational diagram pertaining to the traveling state of an automobile on which the terminal device of the fifth application example of the present invention is being mounted, whereas Figure 7 is a modelwise diagram pertaining to the forward field of vision of the operator of the terminal device of the fifth application example of the present invention, whereas /5 Figure 8 is a modelwise diagram pertaining to the forward field of vision of the operator of a terminal device of the prior art, whereas Figure 9 is a diagram which shows the overall constitution of the fifth application example of the present invention, whereas Figure 10 is a modelwise diagram pertaining to the forward field of vision of the operator of the fifth application example of the terminal device of the present invention.

(1): Signal processing unit; (2): CRT; (3): Optical system; (4): Combiner; (5): Color camera; (6): Automobile; (8): Road information transmission device.

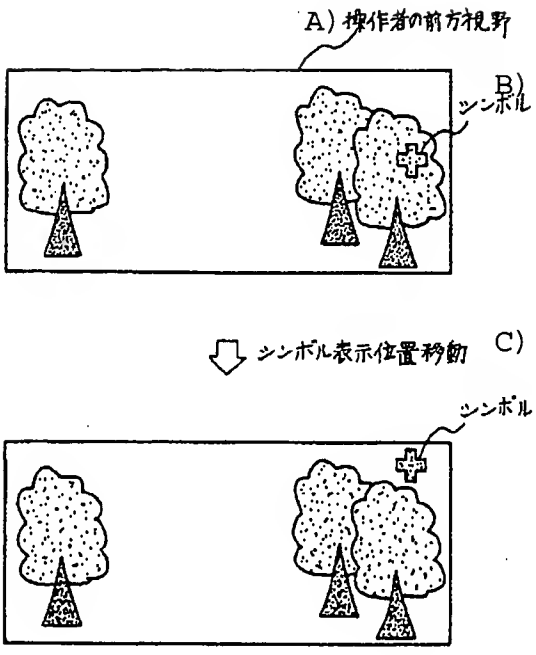
Agent: Katsuo Ogawa, patent attorney

Figure 1



[(A): Operator's eye; (B): Symbol; (C): Type; (D): Color; (E): Brightness; (F): Display position; (G): Sensor, ..., etc.; (H): Image of forward field of vision; (1): Signal processing unit]

第 2 図



第 3 図

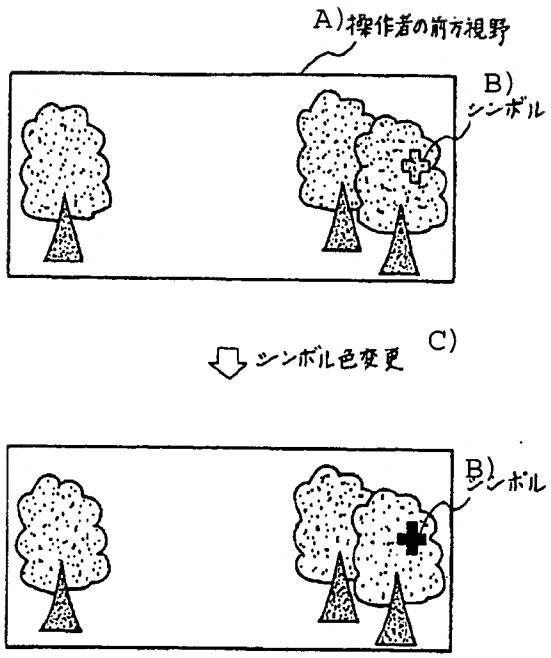


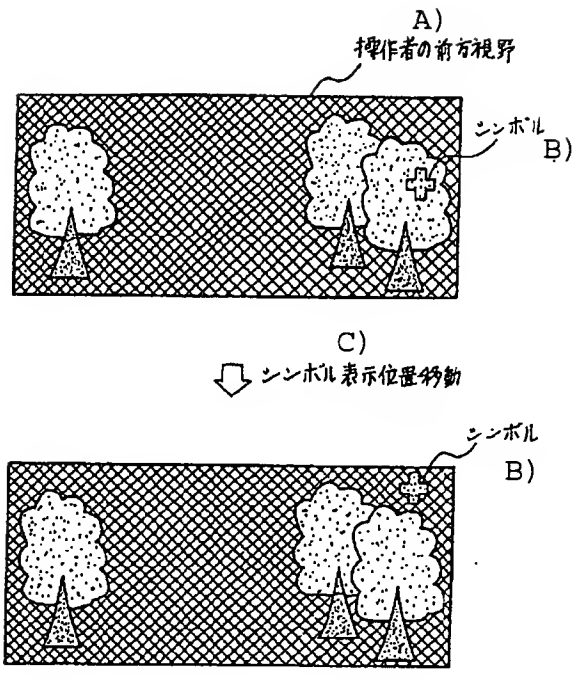
Figure 2

[(A): Operator's forward field of vision; (B): Symbol; (C): Symbol display position shift direction]

Figure 3

[(A): Operator's forward field of vision; (B): Symbol; (C): Symbol color change]

第 4 図



第 5 図

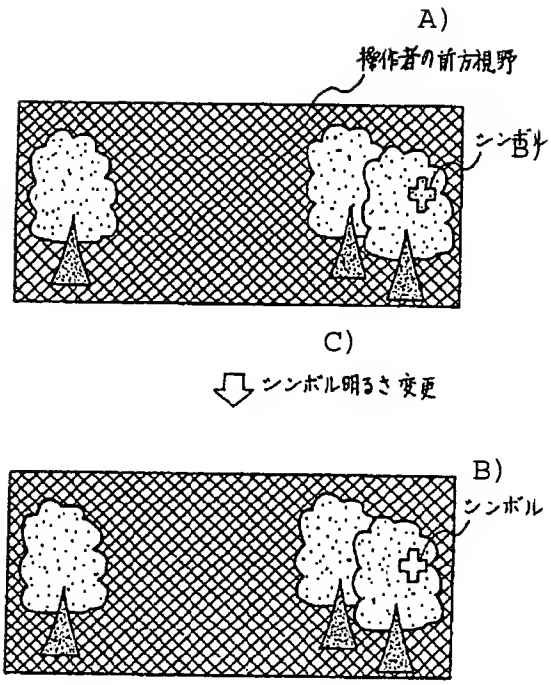


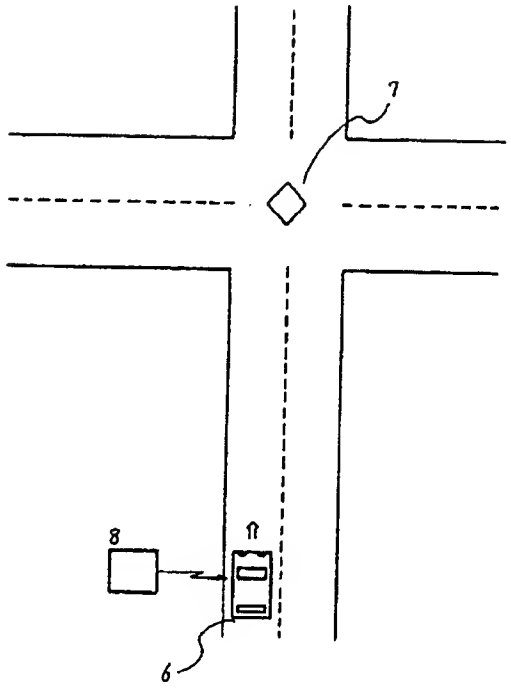
Figure 4

[(A): Operator's forward field of vision; (B): Symbol; (C): Symbol display position shift]

Figure 5

[(A): Operator's forward field of vision; (B): Symbol; (C): Symbol brightness change]

第 6 図



第 7 図

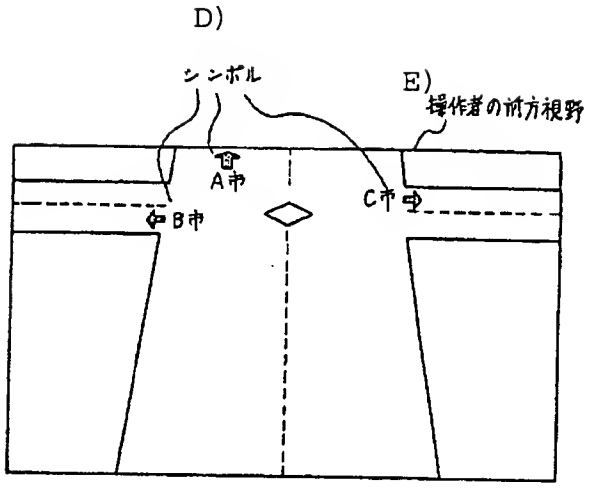
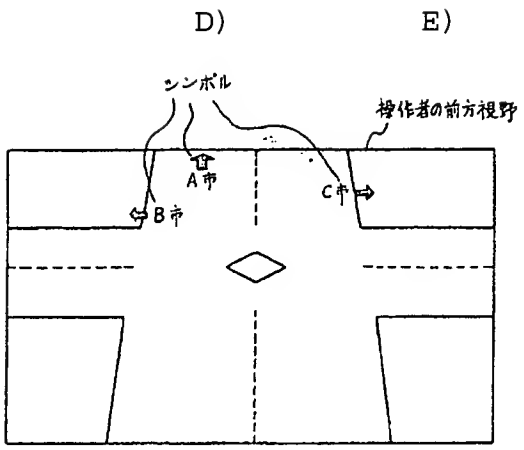


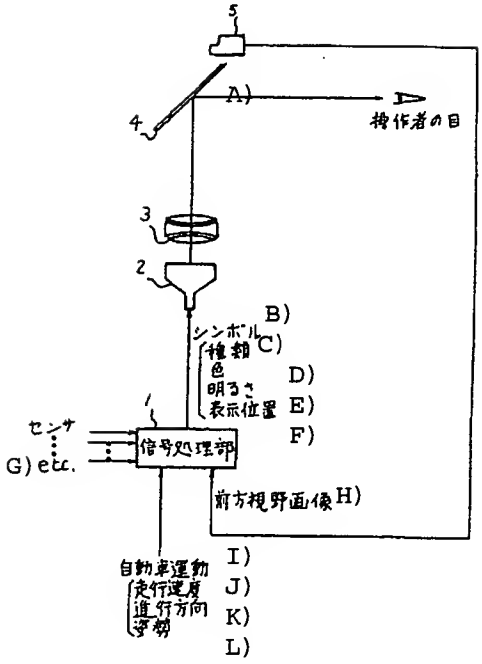
Figure 7

[(A): City A; (B): City B; (C): City C; (D): Symbol; (E): Operator's forward field of vision]

第 8 図


D)
E)
シンボル
操作者の前方視野
A市
B市
C市

第 9 図


5
4
A)
操作者の目
3
2
B)
シンボル
種類
色
明るさ
表示位置
C)
D)
E)
F)
1
センサ
G) etc.
信号処理部
前方視野画像 H)
自動車運動
走行速度
進行方向
姿勢
I)
J)
K)
L)

第 10 図

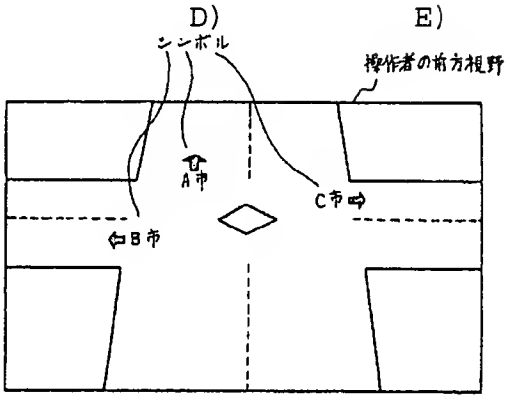

D)
E)
シンボル
操作者の前方視野
A市
B市
C市

Figure 8

[(A): City A; (B): City B; (C): City C; (D): Symbol; (E): Operator's forward field of vision]

Figure 9

[(A): Operator's eye; (B): Symbol; (C): Type; (D): Color; (E): Brightness; (F): Display position; (G): Sensor, ..., etc.; (H): Image of forward field of vision; (I): Movement of automobile; (J): Travelling velocity; (K): Movement direction; (L): Posture; (1): Signal processing unit]

Figure 10

[(A): City A; (B): City B; (C): City C; (D): Symbol; (E): Operator's forward field of vision]